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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MARYLAND
NORTHERN DIVISION

WILLIAM LOCKWOOD, : Civil Action No.: WMN-02-CV-2068
Plaintiff :
:
vs. :
:
PACIFIC CYCLE, LLC :
and TOYS "R" US- :
DELAWARE, INC., :
Third-Party :
Defendants :
:
vs. :
:
SR SUNTOUR, INC. and :
SR SUNTOUR, USA, :
Third-Party :
Plaintiffs :

DEPOSITION OF ROBERT W. HINTON

Taken in the offices of Gallagher Reporting & Video, LLC, 33 South Seventh Street, Suite 105, Allentown, Pennsylvania, on Friday, April 11, 2003, commencing at 4:22 p.m., before Steven R. Mack, Registered Merit Reporter.

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APPEARANCES:

SALSBURY, CLEMENTS, BEKMAN,
MARDER & ADKINS, L.L.C.
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-- For the Plaintiff

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(Hinton Exhibit Numbers 1 and 2 were marked for identification.)

* * *

ROBERT W. HINTON, having been duly sworn, was examined and testified as follows:

EXAMINATION

BY MR. LOPATA:

Q. Sir, my name is Ed Lopata, and I represent the Third-Party Defendants in this case, Suntour, USA, also known as USUL, and Suntour, Inc., from Taiwan. And we're here to take your deposition because you were lucky enough to be retained by Mr. Smith to give an opinion in the Lockwood litigation. And I'm going to ask you some questions regarding your report and regarding this case.

Any questions I ask you, if you could answer yes or no and verbalize your responses. Otherwise we'd appreciate it because the court reporter has to take down everything we say. So don't moan and groan, just say yes or no if you can or just respond to the question. We're going to assume if you respond to one of my questions you completely understood the question.

State your name, sir.

A. Robert W. Hinton.

PLAINTIFF'S EXHIBIT
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date you went over and looked at it or?
A. I'm not really sure of the date. It was obviously before August of 2002, but I'm not sure of when.
Q. All right. Do you have any written materials at all concerning your investigation and inspection of this bicycle?
A. I have -- let me just show you my file. I have a file which is mainly a record of my correspondence with Mr. Smith. And I have some additional information that he had sent to me. And then also some information such as my CV that Mr. Smith had asked for. I have an article that John Schubert wrote about why front forks bend. And I have a very recent entry concerning a statement.
Q. The affidavit?
A. Yeah, an affidavit by Tanaka. The only -- the only engineering type thing that I might have in this whole thing would be just a few estimates that I made concerning the differences in elastic moduli of the two materials and also the thermal expansion coefficients of the two materials.
Q. Okay. We'll look at that.
A. And then I have a second file that's very recent of just depositions or transcripts that were

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submitted to me by Mr. Smith. And again that involves documents and deposition transcripts.
Q. That material was provided to you subsequent to your August 20th, 2002, report?
A. No. I first saw this just a few days ago I believe.
MR. SMITH: Yeah. After your report in other words.
A. Oh, yes, after the report.
Q. What precisely were you asked to do by either Mr. Schubert or by Plaintiff's counsel? As far as your involvement in this litigation is concerned.
A. By Plaintiff's counsel I was asked to render an opinion concerning why the -- the mechanical contact fit between the steering tube and the crown fork separated.
Q. And what was your response to their inquiry?
A. Well, the report pretty much outlines my response to the -- to the reason, at least why I think there was a separation.
Q. And precisely why was there a separation?
A. Well, it's a mechanically -- it's a mechanical fit, which is in -- from my understanding a force fit, between the steering tube which is slightly

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oversize and the -- and that's a steel, thin-walled steel steering tube, and the -- the fork crown is actually an aluminum alloy. And that's undersize. In order to make the mechanical fit, the two are in manufacture pushed together to create a mechanical bond.
The reason I think that we had separation of those two components, in what appears to be normal service of the bicycle, normal use of the bicycle, was the steel tube has a fairly high elastic modulus, it's an elastic stretching condition, and the aluminum alloy has a relatively low elastic modulus.
When you're trying to create a mechanical interference fit, the actual stretching, elasticity of the material is very important. The fact that the aluminum has such a low, relatively low elastic modulus, it's about one-third that of steel, would allow already a loss of about two-thirds of the normal bond strength that you would get with a steel-to-steel interference mechanical fit.
There are other conditions -- and it depends a great deal on the strength of the wall. And this was a relatively thin wall, for the steering tube.
And also there's some influence of

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temperature. In other words if you put -- if you force this together at let's say 65 degrees in a shop and you may be using the bicycle at let's say an 85-degree day, or the sun shines on it and makes it even hotter, then you lose even some of that mechanical interference fit because the aluminum thermal expansion is actually about three times higher than the steel thermal expansion.
So there's a number of reasons that from an engineering point of view I feel this was a relatively weak mechanical fit, that was also subject to deterioration during normal use.
Q. So that mechanical fit with a steel steerer tube going into an aluminum fork crown, crown fork, whatever you want to call it, you're saying that would be a defective design to do it that way?
A. Yeah. The choice of the material certainly would be a very poor choice. The interference fit by itself is also not a good choice simply because in making an interference fit the machine difference between the smaller internal size and the large -- and the oversize steering tube is only on the order of probably one-thousandths of an inch. Maybe slightly more than that.
But that means that your accuracy in

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machining, if you're off by two-ten-thousandths of an inch in either one, you can actually greatly influence the mechanical bond. Because you're losing -- especially if for example the interior is slightly over the specification size or the steering tube is slightly undersize.

You're only dealing with on the order of about a thousandth of an inch. An interference fit normally is made to about one-thousandth per inch of diameter. That's the normal engineering rule.

Q. Well, are you questioning the diameter of the steering tube and the crown fork?

A. Well, all I'm saying is --

Q. Or also are you questioning the fact that they're using dissimilar metals?

A. Well, two problems. The dissimilar metal reduces your mechanical bond strength by about two-thirds of what it may be with a steel-to-steel interference fit. So there's a great loss just in the choice of the metal, in the fact that you have an aluminum alloy on the outside and a steel on the inside.

The thin-wall tube actually further reduces the ability to get a mechanical fit because of

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the -- you're losing some stiffness of the tube, in addition to the modulus.

And all I'm saying is that in a purely interference fit, you can only work with about one-thousandths of an inch difference between the undersize aluminum and the oversize tube. And if there's a slight error in machining that diameter, such as two-ten-thousandths, you lose a substantial amount of your strength.

Q. All right. But you're not aware of anything in this case that there was an error as far as the diameter?

A. No. There's no way at this point to measure the diameters because again there's a great deal of wear, slippage, metal smear. And so a measurement at this point would not be very significant. The measurement would have to be taken prior to the interference fit when -- during manufacture.

Q. So if that's true, how could you say with a reasonable degree of engineering certainty that the separation occurred as a result of an error being made as far as the diameter of the materials used?

A. Well, I'm saying there are two things that are add -- that are additive. One is the choice of

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materials reduces your bond strength by a factor of two-thirds. And that's a major factor. In other words you're not dealing with a great deal of extra strength to begin with of this press fit or mechanical fit condition. And a very slight machining error would actually reduce that strength even further.

Q. But you don't have any evidence of a machining error?

A. No. I can't really measure -- that's true. I can't make a measurement on what's left because the actual fit now is loose. It's -- you can take it apart, put it together and -- which indicates to me that the small amount of interference that was in the material, when it actually broke the bond and came apart, is gone. There's really nothing left to that interference, because it's now a loose fit -- a loose fit.

Q. Okay. But I was just going to your testimony that it could have been because of some error being made as far as the diameter in like the milling process or whatever you want to call it.

A. In the machining. Yeah. It's very difficult to maintain two-ten-thousandths of an inch in machining tolerance.

Q. Yeah. But in this case you don't know

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whether that's true or not?

A. No. In just general terminology that in machining it is difficult to maintain a tolerance of two-ten-thousandths of an inch.

Q. Now, you talked about a mechanical fit. Correct?

A. Yes.

Q. Okay. And do you know the methodology that was used to make the mechanical fit in this case?

A. No. There are only two possible ways. I saw no evidence at all of any adhesive in the -- in the joint. So I'm assuming it's a mechanical fit that can either be a press fit, where you just mechanically press it together, or the alternative to that is a thermal expansion where you actually thermally expand the crown fork, by heating it.

Q. Okay. Would you explain the difference between the two of what's trying to be achieved?

A. Well, in a thermal fit you actually grow the diameter of -- the outside diameter through increase in temperature. Because steel or alloys, aluminum alloy in this case, would actually grow in size with temperature. Very slightly, but it's enough to make it another half-thousandths or even a thousandths if the temperature's high enough.

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You know. We have no record of abuse here, but. It would take a high load to break the joint I think initially. But only one load. And you probably wouldn't know that it -- initially you broke the joint. You may use the bike for hours, days, weeks before that actually -- once the joint is broken, then it can be worked loose with normal operation. There's no safety device on this to prevent it from pulling out.

Q. Are you aware of any -- I take it you're not aware of any industry standards concerning whether there should be, quote, a safety device, quote, as you just alluded to as of May 1997?

A. No, I'm not aware of industry standards, concerning that.

Q. You're not aware of any statute or regulations or anything, any type of requirements?

A. No. I don't know the business.

Q. In paragraph Number 1 you refer to thermal expansion coefficients, et cetera, you say you've attached to the report. Can you explain to me what you're referring to, sir?

A. Yeah. The first attachment, Table A-7 entitled Physical Constants Of Materials, lists the modulus of elasticity of a number of alloys and steels

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and irons. And what I was most interested in here, the aluminum, the modulus of elasticity, the essentially elastic stiffness of aluminum is only 10.3 in the first column. And if you look at carbon steel, it's 30.

Now, this is a physical property, and therefore the alloy content can vary widely, in aluminum and in steel, and the strength can vary widely. But the elastic modulus is a physical property which remains relatively constant, within a few percent, for all alloys of aluminum for example and all alloys of steel.

So the fact that the aluminum is only one-third as elastic as steel indicates to me that you would lose essentially two-thirds of your strength in an interference fit in which the aluminum is on the outside diameter and the carbon steel is on the inside diameter.

Q. Because the fit would only be as strong as the aluminum alloy?

A. Yes. The aluminum is really giving up three times the compressive -- in tension, it's giving up three times the stretch of the carbon steel. And that makes the joint weaker.

Q. Even though that they have been thermally

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bonded or mechanically fitted into place?

A. Yes. Either thermal or mechanical would still see this difference. This is a physical difference. It's fundamental. So it doesn't matter how -- whether -- how you put it together.

And there's also going to be -- if you try to thermally fit this together and get an extreme interference fit, there's going to be a limit from the aluminum strength. It will eventually yield. And then that also gives you a limitation to the aluminum.

Q. So as you force this thing in there and it's in there as tight as it can possibly go, you're saying over a period of time it's going to weaken. Just because it's steel and aluminum.

A. No. What I'm saying is that the original bond -- if you were forcing steel into steel, steel OD, steel ID, you would have a bond strength that would be three times what you're doing with aluminum OD, steel ID.

Q. Right.

A. Because of the elastic modulus. So you're starting out with a bond strength of this mechanical fit that's one-third of steel to steel.

Q. Okay. But as we have establish -- I think

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as we have established here through your testimony, the fact that it's not steel to steel doesn't necessarily mean that it violates any industry standards?

A. No. That's true.

Q. Okay. And my question to you, we have aluminum and we have steel, and you stick it together as hard as you possibly can get it together. Okay. What causes it to separate then? What happens to the metal? Is it something that happens to the metals or? Or you don't know?

A. Yeah, I -- in the case of the failure, the failed bike, I really don't know what happened. I can speculate, but -- it obviously separated, so something broke the bond. Whether it was normal use or some overload condition, I really don't have the history to -- but I can tell you that something, once the bond is broken, it's only broken once.

Q. All right. In Number 3, you're talking about "Mechanical and physical properties of carbon steel and aluminum alloys are attached." You haven't made any determination that this was carbon steel that was in this Duotrack?

A. No. Again I'm quite sure it's steel, because of its appearance. But I certainly don't know

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the grade of steel that has been used.
Q. Okay.
A. There is a -- I thought I saw -- well, I don't see it listed either. Neither the fork nor the fork steerer tube materials are ID'd in this CBC9626MG/S Strike specification sheet.
Q. All right. And as far as Number 3 is concerned, your paragraph Number 3, it says "Mechanical and physical properties of carbon steel and aluminum alloys are attached." Could you point to me what you were considering? Lineal Thermal Expansions of Metals and Alloys?
A. Well, we just discussed the thermal expansion of the alloy. But in item 3 of my report, page 2, mechanical and physical properties; the physical properties would be the elastic modulus that we just discussed on Table A-7.
Q. Okay.
A. Another physical property that has some relevance is the linear thermal expansion table, which is listed as page 23, and I have noted ASM Metals Handbook reprinted in 1958. And the coefficient of thermal expansion is how much does the metal expand per degree, in this case centigrade.
And then in general aluminum alloys

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are -- cast aluminum alloys are frequently around 20 -- 22 millionths of an inch per degree centigrade.
If you look at the iron and steels, and I assumed this is a low carbon steel, such as .06 carbon, for the steerer tube, that expansion coefficient is about 11.7 millionths of an inch per degree centigrade.
And what that really means is the aluminum expands twice as much for every degree centigrade or every degree of heating, the aluminum actually grows twice as much as the steel. So on a hot day -- let's say that the whole thing was pressed together in a shop. Let's say it was maybe 50 degrees in the shop.
If you're using the bike out at 85 degrees and the sun -- and you got maybe additional temperature from the sunlight, that extra between the difference between the 50 degrees and the 85 degrees Fahrenheit, convert those to centigrade. So we're dealing with maybe 15, 16 degrees centigrade. That actually would expand the outer collar or fork, and the inside would not expand as much. So it would actually reduce the strength of the joint.
Q. Let me see if I understand. This is the fork crown, right? (Indicating.)

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A. Right, the fork crown.
Q. You're saying depending on the temperature, the aluminum would expand on the outside of this --
A. Well, this whole item would expand twice as much as the steel steerer tube inside.
Q. And so it would be the -- the whole component part here that I'm looking at, the thing that goes across the wheel of the bicycle, as well as the --
A. Yeah, the contact area around.
Q. Contact area. And the outside would expand more than the inside of this metal would expand?
A. Yeah. About twice as much.
Q. About twice as much.
A. Yes, according to the numbers.
Q. No, but I'm just asking you about the crown fork now where the steering tube goes into. Wouldn't the inside of this also expand out?
A. Well, it's expanding out. And the tube itself expands out.
Q. Yeah, but it's sort of like when your throat gets swollen because you got strep throat, the inside of it expands, too, as well as the outside.

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A. What I'm saying is if it were made steel to steel, they would go together. And so your bond strength would not change.
Q. Okay.
A. But the fact that it's aluminum alloy and it's expanding twice as much for every degree centigrade that you heat this component, the steel's therefore not growing as fast, and therefore you're going to lose some bond strength with higher temperature.
Q. My question though, wouldn't the inside of this aluminum part also expand?
A. Well, the aluminum expands, yes.
Q. Yeah. You're going this way, but I'm also -- wouldn't it also be expanding inward this way?
A. No.
Q. If you have the metal tube in there like this and the aluminum was going to expand more, wouldn't it also expand on the outside of the aluminum as well as the inside of the aluminum?
A. Well, the -- if you were to make very accurate measurements, and at let's say room temperature, of the hole, and then you heated it 200 degrees centigrade. Let's say 200 degrees centigrade. And you measure the hole diameter. The hole actually

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The other possibility is you have a joint much stronger than anything that you can do to it in normal use and you had an event somewhere along the way that may have broken that joint. And it could have been an event that nobody really noticed or knew about. And once the joint is broken, then normal use can really make that wear slightly and separation would occur.

Q. So either one of those possibilities are equally possible?

A. Yes. I don't have a firm opinion because I don't have the -- either the background or the measurements.

Q. So it could be either way, you just can't tell?

A. Yes.

Q. So then as far as your summary is concerned on page 2, "The press-fit and/or the thermal interference fit between the thin-walled hollow steerer tube and the nonferrous fork crown of the bicycle in question is inadequate, unsafe;" you can't really say that, can you, because you don't have the facts, because you don't know what the strength was?

A. Let's see. Where is that.

Q. In summary.

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A. Summary. Oh, in summary. Well -- okay. It's certainly in question -- I strongly believe that type of mechanical joint could be inadequate.

Q. I understand.

A. So "is" probably is not the right word.

Q. So you're saying it's possible?

A. It's possible.

Q. But you can't say it's probable?

A. I think that type of joint is unsafe because there is no real safety. Once it's broken, it's really on the road to separation. And it cannot be retightened or inspected. And that's true probably of any joint that may be put there. But most joints, if they're welded, brazed, or even bonded with an adhesive, are probably a higher quality, higher strength joint than what we're dealing with here.

Q. But you're not aware of any industry standards in May of 1997 that called for if a fit has been broken, that it should be able to be retightened or inspected. You're not aware of any?

A. No. All the joints I'm aware of are once-and-done manufactured joints.

Q. And once --

A. So that's true. They cannot be retightened.

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Q. And they can't be inspected because of where they are when you're looking at them?

A. That's correct, yes.

Q. The only way you can tell is if you actually did a test for that specific purpose?

A. Well, again the test would be a destructive pull test or a torque test. But it's not a functional test.

MR. LOPATA: Thank you.

MR. SMITH: I actually have some questions.

* * *

EXAMINATION

BY MR. SMITH:

Q. The bond in this case broke?

A. Yes.

Q. Now, if a bond in a bicycle like this which is hidden breaks through normal and expected use, that would be a defect?

A. Yes.

MR. LOPATA: Objection.

Q. Now, what you're saying is because no information has been supplied to you by the manufacturer, who deals directly with the fork manufacturer so should be able to get the information,

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they have been unable to get that to you, you have been unable to test any of your hypotheses but based on your knowledge of engineering principles and the attachments that you had, this particular bonding, it's a thermal -- if it's a --

A. Mechanical.

Q. -- mechanical fit of the aluminum alloy on the outside to the hollow metal steerer tube on the inside is not as strong as steel to steel?

A. Yes.

Q. And based on everyday and normal use in changing weather patterns, the aluminum can expand in such a way that it would lead to an increased likelihood of the bond becoming loosened and therefore damaged?

MR. LOPATA: Objection. No evidence in this case. But go ahead.

A. Yeah. It's certainly -- in hotter weather it's going to be -- the bond strength is going to be lower.

Q. And the only reason you haven't been able to test anything is because the materials haven't been supplied.

MR. SMITH: I will represent that we didn't do the destructive testing because I had said